(a) By KVL, \( V = I*R + e_{\text{ind}} \); initially, when switch first closed, the velocity of the bar is zero \( e_{\text{ind}} = 0 \). Therefore, \( I_{\text{start}} = V/R \) independent of \( B \) and \( l \). [a: 24/0.5 = 48; b: 50/1 = 50; c: 12/0.5 = 24; d: 80/1 = 80; e: 100/1.5 = 66.67]

(b) The ratio of \( V_{\text{sc}} \) required to produce \( I_{\text{rated}} \) to \( V_{\text{rated}} \) is independent of which side of the transformer the source is on. [a: \( 11.25/120 = x/480 \) \( \Rightarrow x = 45 \); b: \( 144/2400 = x/480 \) \( \Rightarrow x = 28.8 \); c: \( 45/480 = x/120 \) \( \Rightarrow x = 11.25 \); d: \( 28.8/480 = x/2400 \) \( \Rightarrow x = 400 \); e: \( 400/8000 = x/240 \) \( \Rightarrow x = 12 \)]

(c) Power factor = \( \cos(\text{angle of } Z) \); leading if \( \text{angle of } Z < 0 \) and lagging if \( \text{angle of } Z > 0 \). [a: \( \cos(+150) = 0.966 \) lag; b: \( \cos(+250) = 0.906 \) lag; c: \( \cos(-150) = 0.966 \) lead; d: \( \cos(-250) = 0.906 \) lead; e: \( \cos(-100) = 0.985 \) lead]

(d) For ideal transformer, \( R_{\text{eq}} \) & \( X_{\text{eq}} \) independent of which side referred to; \( R_{\text{c}} \) & \( X_{\text{m}} \) independent of which side referred to.

2. With transformer parameters given referred to the primary, then
\[
V_{\text{p}} = \frac{I}{a} \cdot (R_{\text{eq},p} + jX_{\text{eq},p}) + a \cdot V' \quad \text{where} \quad a \text{ is the turns ratio as given by the voltage ratings.} \]

3. One approach is to convert the \( \Delta \) load to an equivalent wye and combine the 2 impedances in parallel; then
\[
S_{\phi} = \frac{V_{\text{line-line}}}{\sqrt{3}} \cdot \text{conjugate}\left(\frac{V_{\text{line-line}}}{\sqrt{3}} / Z_{\text{par}}\right), \quad S_{\phi} = 3 \cdot S_{\phi} + j 3 \cdot Q_{\phi} \]

4. By using KVL, it can be shown that \( V_{AB} = V_A \cdot [\sqrt{3} \cdot +30^0] \) for positive sequence, i.e., ABC sequence; a similar relationship exists for \( V_{BC} \) & \( V_B \) and for \( V_{CA} \) & \( V_C \). Convert given line-line voltage to an appropriate line-neutral voltage, if that line-neutral voltage corresponds to the phase for which the current is required, the simply \( V_{\text{line-neutral}} / Z_{\phi} \). If a different phase current is required, can either shift the line-neutral voltage by \( + \) or \( -120^0 \) or can shift the current to the appropriate phase. [a: \( V_B = 277 \cdot -45^0, I_B = 11.54 \cdot -65^0 \); b: \( V_A = 120 \cdot +60^0, I_A = 11.54 \cdot +80^0 \); c: \( V_B = 277 \cdot -45^0, I_B = 11.54 \cdot -60^0 \); c: \( V_C = 277 \cdot -20^0, I_C = 11.54 \cdot -40^0 \); d: \( V_B = 120 \cdot -195^0, I_B = 5.77 \cdot -205^0 \); d: \( V_C = 277 \cdot -75^0, I_C = 11.54 \cdot -70^0 \)].

5. (a) ideal voltage regulation = 0, i.e., there is no change in voltage as the load changes.

(b) Transformer open circuit test \( \Rightarrow R_c \) & \( X_m \) which are the core parameters; transformer short circuit test \( \Rightarrow R_{\text{eq}} \) & \( X_{\text{eq}} \) which are the winding parameters.

(c) \( X @ \beta \leftrightarrow \sqrt{2} X \cos(2\pi ft + \beta) \) [a: \( v(t) = \sqrt{2} 277 \cos(120\pi t -20^0) \); b: \( v(t) = \sqrt{2} 120 \cos(120\pi t - 15^0) \); c: \( v(t) = \sqrt{2} 277 \cos(120\pi t + 18^0) \); d: \( v(t) = \sqrt{2} 120 \cos(120\pi t + 25^0) \); e: \( v(t) = \sqrt{2} 480 \cos(120\pi t - 30^0) \)]

(d) RL circuits are lagging power factor and RC circuits are leading power factor.